

PATENT

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Attention: Examiner G. Perez, (Fax No. (703) 305-3432) on 11/2/2001

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In re application of:
Suzuki

Serial No.: 09/453,772

Examiner Perez

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Group Art Unit 2834

For: ACTUATOR

Assistant Commissioner for Patents
Washington, D.C. 20231

PROPOSED RESPONSE C AFTER FINAL

Applicant proposes the following remarks in response to the Final Office Action dated July 5, 2001. If the Examiner is in agreement that the present claims are allowable, then Applicant will formally file this response along with a Petition for a One Month Extension of Time with the appropriate fee.

Remarks:

Claims 1-10 remain pending in the application. In the previous Office Action dated October 25, 2000, claim 1 was rejected as being an obvious combination of the cited Komatsu and Atsumi references. In response to this rejection, Amendment and Response B was filed which amended claim 1 to recite that the rotor is "adapted to be held in a rotational position by a detent torque when said coil is deenergized"; a feature which both Komatsu and Atsumi fail to disclose, teach, or suggest.

In response to this amendment, the Office uncovered the cited Tojo reference (U.S. Patent No. 5,996,554) upon which a final rejection of claim 1 for obviousness in combination with Komatsu and Atsumi was based. The Final Office Action contends that Tojo teaches the above-quoted feature of claim 1 missing from Komatsu and Atsumi. More specifically, the Final Office Action states that Tojo "discloses that the rotor is to be adapted to be held in a rotational position by a detent torque when the coil is de-energized" for the purpose of "controlling the throttle valve of an air-passage."

However, it is Applicant's position that the Tojo reference does not teach or suggest the limitation of a rotor being "adapted to be held in a rotational position by a detent torque when said coil is deenergized" because Tojo teaches that its throttle valve control device should be designed to eliminate detent torque. (See Tojo, column 1, line 64 through column 2, line 8). To hold the rotor in a rotational position during coil deenergization, Tojo instead teaches that a biasing spring be used. Given that Tojo teaches the elimination of the very force used by Applicant to control rotation and reduce power consumption, Applicant submits that the obviousness rejection is improper and should be removed.

I. The Actuator of the Present Invention

Figures 3, 4, and 5 of the application show torque characteristics of the actuator of the present invention. In the figures, the rated torque is the torque generated when the coil is energized at a rated current. The detent torque is the torque generated when the coil is in a deenergization mode. The angle θ is the relative angular difference between the rotor and the stator. Figures 2(a) and 2(b) illustrate the basic rotational characteristics of the rotor in response to coil energization in the direction of I_1 (clockwise rotation) and I_2 (counter-clockwise rotation).

As can be seen in Figure 4 and the accompanying description in the specification (see Application, page 14, line 7 - page 15, line 15), the rotor will carry out repetitive rotational movement within the angular range of θ_2 to θ_1 . If the rotor lies between θ_3 and θ_1 , and the coil is in a deenergization mode (meaning there is no rated torque and that the resultant torque is in effect the detent torque), the rotor will be rotated in the clockwise direction by virtue of the positive detent torque until the rotor reaches the position of θ_1 where rotation is stopped by a stopper.

While held in position at θ_1 , if current is passed in an I_2 direction, then the rotor overcomes the positive detent torque as the magnitude of the negative rated torque at position θ_1 is greater than the magnitude of the positive detent torque at position θ_1 , thereby making the resultant torque negative and driving the rotor in the counterclockwise direction. If the duration of energization in the I_2 direction is sufficiently long, the rotor will eventually stop at the position of θ_2 .

If the duration of energization in the I_2 direction is short, and current is cut off before the rotor reaches θ_3 , then the rotor is moved back to the initial position θ_1 by a positive detent torque. If the duration of energization in the I_2 direction is long enough to move the rotor past position θ_3 toward θ_2 , and then the coil is deenergized by cutting off the current, then the rotor will be driven and held at position θ_2 by virtue of the negative detent torque that exists between position θ_2 and θ_3 .

While held at position θ_2 , if the current is switched to the I_1 direction, the rotor will begin moving clockwise toward θ_1 by virtue of the resultant torque being positive. As explained above, if the I_1 direction current is cut off before the rotor reaches position θ_3 , then the rotor will be driven back and held at the θ_2 position by virtue of the negative detent torque. If the I_1 direction current is cut off after the rotor passes the θ_3 position but before the rotor reaches position θ_1 , then the rotor will be driven forward and held at the θ_1 position by virtue of the positive detent torque.

"Thus according to the present invention, each time the energizing direction of the coil is switched, the rotor carries out repetitive motion in the range defined by θ_2 and θ_1 , and the rotor can be set in a given direction *by making use of detent torque even when the coil is in deenergization mode.*" (See Application, page 15, lines 16-21 (emphasis added)). Because the actuator of the present invention can maintain its rotor position even when the coil is deenergized, "the present invention can be applied to, for example, a camera shutter or the like to always hold the shutter closed by the detent torque, open the shutter only for a required period of time by energizing a coil only when taking a photograph (for exposure), then close the shutter by inverse energization. Thereafter, the energization can be cut off to maintain the shutter in the closed state by the detent torque." (See Application, page 15, line 25 - page 16, line 6). This

feature is extremely effective to achieve power saving because current is not required to keep the shutter closed.

II. Tojo fails to teach or suggest the use of detent torque to maintain the rotor's position when the coil is deenergized because Tojo teaches the elimination of detent torque.

The Office Action cites the Tojo reference as supplying the teaching that detent torque be used during coil deenergization to hold the rotor in a rotational position. However, Tojo teaches quite the opposite. Tojo states that the detent torque that exists when the driving coil is turned off is an undesirable feature that causes a need for a large spring force to hold a rotor closed. This large spring force necessitates a large electromagnetic force to drive the throttle valve against the spring force during coil energization, thereby requiring an unnecessarily large-sized torque motor to produce such electromagnetic force. (See Tojo, column 1, lines 23-45).

To improve such motors, Tojo teaches that the stator core be designed to have "a smooth inner periphery with no slot, so that unevenness in the distribution of the magnetic flux density in the stator core can be reduced." (See Tojo, column 1, line 64 - column 2, line 1). Tojo states that as a result of this stator core design, "the detent torque applied to the rotor when the rotor is rotated without current supplied to the solenoid can be eliminated." (See Tojo, column 2, lines 1-3). This elimination of detent torque allows for a reduction in the amount of electromagnetic force needed to drive the throttle valve control device, which thereby allows the device to made smaller and use less power. (See Tojo, column 2, lines 3-8).

Thus, Tojo teaches the elimination of the very property that Applicant utilizes in controlling rotational movement. As such, Applicant respectfully submits that the obviousness rejection based on the combination of Tojo with Komatsu and Atsumi is improper because a person of ordinary skill in the art, upon reading Tojo, would be directed to design an actuator exhibiting no detent torque rather than an actuator that utilizes detent torque to hold the rotor in a rotational position when the coil is deenergized.

Rather than using detent torque to hold the rotor in a rotational position during coil deenergization, Tojo teaches that a return spring should be used to bias the rotor to a rotational position during coil deenergization. (See Tojo, Figure 2, reference numeral 17; column 4, lines 39-47). To achieve rotor movement during coil energization, the driving current must be of

sufficient magnitude to generate enough torque to overcome the biasing force of the spring. (See Tojo, column 4, line 66 - column 5, line 2).

Thus, the Tojo reference teaches one of ordinary skill in the art how to eliminate detent torque from a motor and how to use a spring to bias the rotor position during coil deenergization. As such, Tojo fails to provide any teaching that would render claim 1 obvious, and in fact, teaches away from Applicant's invention.

"[A]ll relevant teachings of the cited references must be considered in determining what they fairly teach to one having ordinary skill in the art. [citations omitted] The relevant portions of a reference include not only those teachings which would suggest particular aspects of an invention to one having ordinary skill in the art, but also teachings which would lead such a person away from the claimed invention." In re Mercier, 185 USPQ 774, 778 (CCPA 1975). Proceeding contrary to the accepted wisdom of the prior art is strong evidence of nonobviousness. W.L. Gore & Associates, Inc. v. Garlock, Inc., 220 USPQ 303, 312 (Fed. Cir. 1983).

In this case, Applicant has proceeded to the contrary of the teachings of Tojo to develop an actuator which uses detent torque to hold the rotor in a rotational position when the coil is deenergized. If Applicant had relied on the teachings of Tojo in developing the present invention, the actuator would have been designed such that the detent torque is eliminated and a spring is used to hold the rotor in a rotational position when the coil is deenergized. Instead, Applicant has used the motor's detent torque to his advantage by relying on the detent torque to hold the rotor in a rotational position during deenergization, thereby eliminating the need for the spring used by Tojo. This innovation in actuator design is not found, taught, or suggested in the cited references. Therefore, Applicant respectfully submits that claim 1 and all depending claims are allowable.

III. Conclusion

For the foregoing reasons, Applicant respectfully submits that the obviousness rejection of claim 1 is improper. The cited references fail to teach or suggest an important feature of Applicant's invention - the use of detent torque to hold the rotor in a rotational position when the coil is deenergized. Tojo, which is cited for disclosing this limitation, in fact teaches that detent torque should be eliminated and that a biasing spring should be used to hold the rotor in a

rotational position during coil deenergization. Accordingly, the Komatsu/Atsumi/Tojo combination fails to render claim 1 obvious. Also, for the reasons stated in sections II, III, and IV in the previously-filed Amendment and Response B, Applicant reiterates his position that claims 6, 7, and 10 are separately allowable. Favorable action is respectfully requested.

Respectfully submitted,

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